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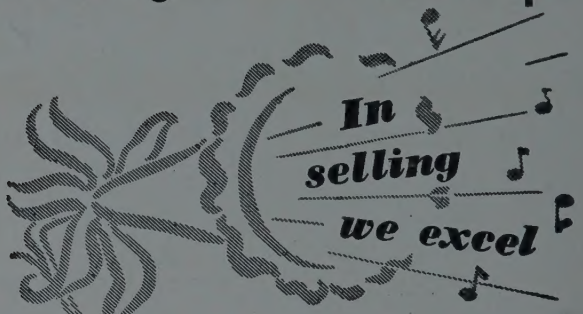
DARLINGTON'S Mushroom News

A QUARTERLY JOURNAL FOR MUSHROOM GROWERS

Vol. VII No. 8 APRIL 1960

Blowing our own trumpet



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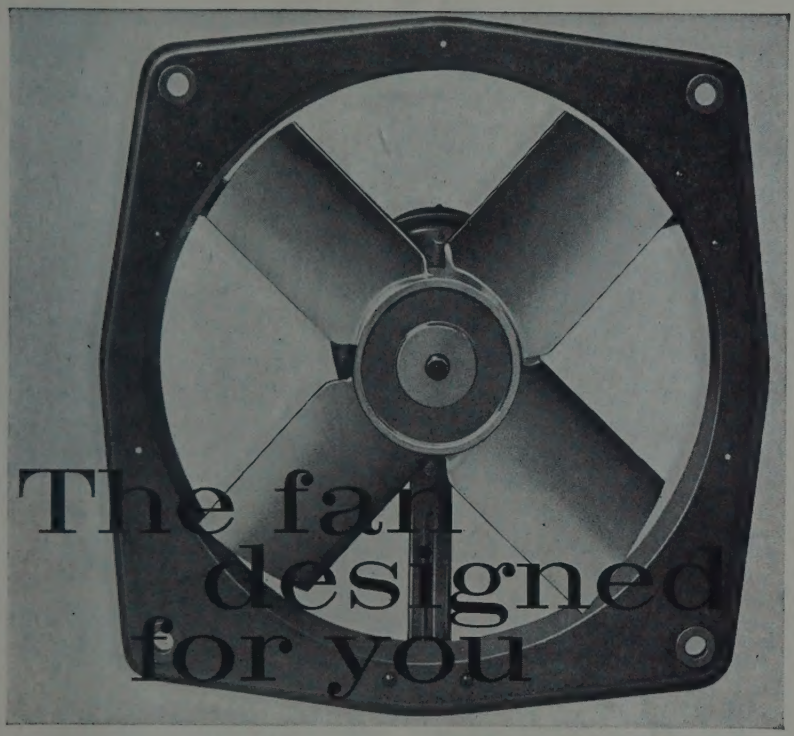

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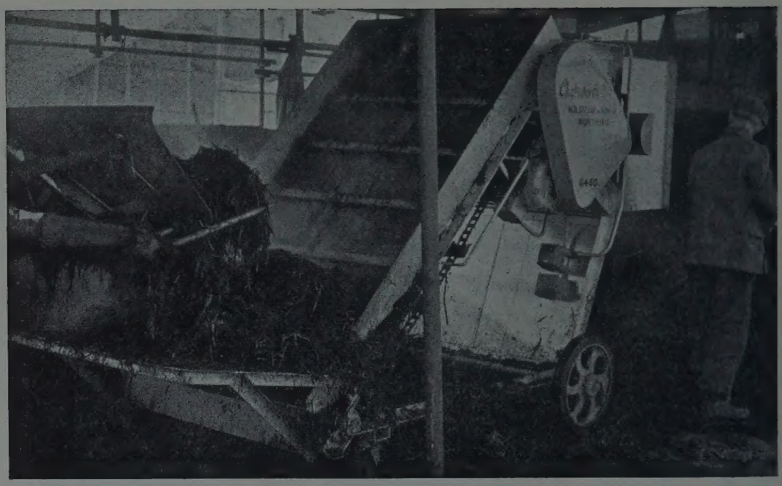

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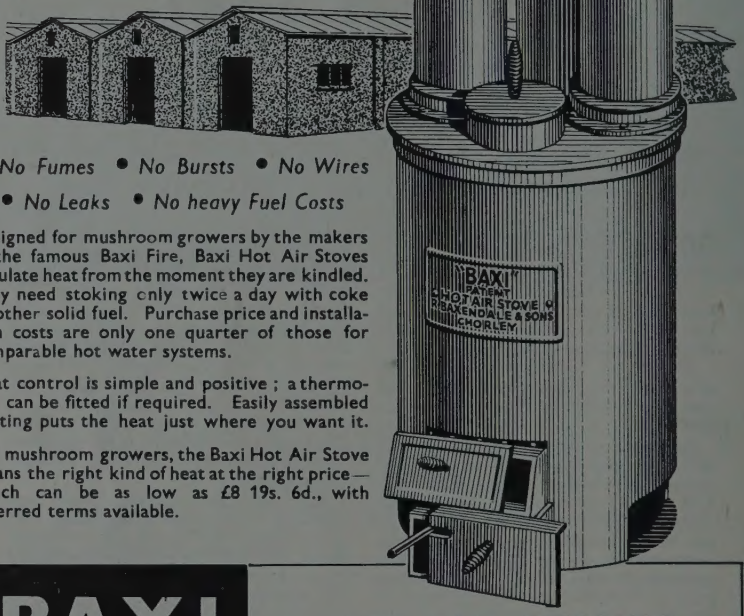

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Mushroom News

Vol VII No. 8 APRIL 1960

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OUR FRONT COVER

With improved cropping reported from many farms the camera caught a pretty girl on her way to the packing shed with some fine samples of mushrooms grown on 100% Grain Spawn. *(Photograph reproduced by kind permission of the Editor of "The Smallholder.")*

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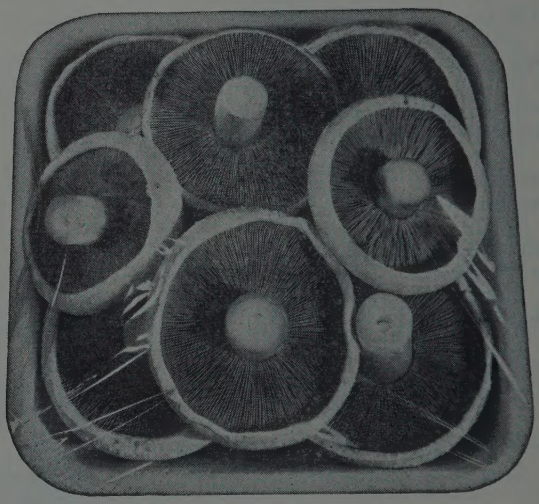

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Mushroom News

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WORTHING ENGLAND

Vol. VII No. 8 **APRIL 1960**

Research and Experiment

MR. Stanley Middlebrook recently propounded the heretical point of view that there should be less rather than more research into the cultivation of mushrooms, for if there are already too many mushrooms going to market, then improved cropping will only make the position worse. We say "heretical" because the orthodox view today is that there should be more research and more 'experiment' stations provided at the taxpayers expense to cope with the desire of the mushroom grower to have someone else tell him how to grow more mushrooms.

Now neither Mr. Middlebrook nor anybody else can stop research for it is part of the nature of man to keep on asking 'why?' and if he cannot find the answer himself he will goad cajole or pay someone else to find it for him. But it is surely time to take stock of the position for there is danger that the word 'research', expressed without proper understanding, may be given magical properties and all the troubles of the industry will be blamed upon the lack of research when they should be rightly attributed to other, less exciting, causes.

Apart from the research carried out by commercial companies the only basic mushroom research station in the country is the Glasshouse Crops Research Institute at Littlehampton. There a team of research workers are enquiring into the fundamental problems of mushrooms growing; their work is unspectacular, for epoch-making discoveries do not happen every day and 99 per cent of research work is hard, methodical slogging to produce papers that can be understood by a limited few. Some growers are critical of the work carried out at Littlehampton because they do not understand the nature of the problems being tackled.

What growers have in mind when they talk of 'more research' are experimental stations where practical mushroom growing is carried on using new experimental techniques and it goes without saying that what is required of such stations is a practical method of producing more pounds per square foot. It is here that we find ourselves on the same side of the fence as Mr. Middlebrook, if not for the same reason. During the last ten years there has been a torrent of new ideas about mushroom growing surging from experimental stations all over the world, most of them supported by experimental evidence to show that yield per square foot can be in-

creased by fifty or a hundred per cent. We say experimental evidence because often these new ideas, when tried out commercially, have not increased yields at all and in some cases have depressed them to disasterous levels.

There is no lack of new ideas. If anything there are too many new ideas and a halt should be called to them until some of the more promising ones have been digested. The question is — who is to do the digesting? If new experimental stations are established, they can do one of two things. Either they can contribute to the torrent of new ideas, or they can check the work of other stations. But all the information is available to growers, and it would seem to be unnecessary to re-examine the evidence, carry out large-scale trials, and produce papers about papers, all at the taxpayers' expense.

At the risk of being repetitious we will again mention Mr. Middlebrook who said 'The best experimental station is one's own farm', and never spoke a truer word. Every mushroom farm is indeed an experimental station and it is within the power of many growers to increase their yields by substantial amounts simply by doing the job properly. There are a surprising number of growers who are prepared to try out some new method of cultivation before they have properly mastered such a basic essential as composting correctly. They are so busy looking for a gimmick that will give them a big increase in yield that they do not see that ordinary day-to-day jobs are not being carried out correctly on their farms with a consequent loss of as much as a half pound per square foot on every crop.

New ideas are essential if an industry is not to stagnate. The crazy notion of today may be the orthodox technique of tomorrow. But new ideas will stand or fall on the results they give on the mushroom farm and it is worth remembering that nearly every advance in mushroom growing has been the result of a practical trial and error by growers themselves aided by the technical advisers of commercial firms. On the results achieved so far there is a very good case to be made for no more 'experiment' stations until the present back-log of ideas produced by existing stations have been put to the acid test of commercial production.

Notes and News

The Bill.

The Horticultural Bill received the Royal Assent on the 22nd March, 1960. The draft of the £8,000,000 scheme for horticultural improvements which is authorised by the Bill was laid before Parliament the following day.

Growers with the necessary qualifications will be able to apply for grants of not less than £100 from the 1st April, and applications should be made to local officers of the Ministry of Agriculture. Growers must find two-thirds of the sum for the improvement, the Government providing one-third as an outright gift.

Purposes for which the grant can be used that are of special interest to mushroom growers include im-

provement of the heating system of mushroom houses, laying on of electric light and water supply, and the erection of packing sheds.

Midlands Mushrooms,

A talk on mushroom growing by Mr. Eady and Mr. Checkley of St. Mary's Nurseries, Market Harborough, was given to the Leicestershire Commercial Horticultural Discussion Society.

After spawning and spawn running, they said that a shock was needed to initiate the actual formation of the mushrooms, and this was administered by the surface cooling and drying by evaporation resulting from capping or casing the compost.

The Economics of the Mushroom.

The *Financial Times* had a feature article on the mushroom industry in its issue of the 17th February. The article was unsigned, and the writer stated that it was held that a capital investment of 20 to 25 shillings per square foot was necessary for setting up a large modern farm. The average price of mushrooms was given as 2/9d. to 3/-, with seasonal variations from 1/- to over 4/6d.

The article went on to say that profits varied widely, and gave an opinion that a grower taking 2000 lb. a week off beds of 20,000 square feet might be making 6d. a pound at the average price of 3/-.

Agricultural Wages.

The wage structure for agricultural workers was amended from the 22nd February, 1960. The standard working week is to be 46 hours, but to meet the strong argument put forward by the employers that it would be extremely difficult to give the whole hour reduction on Saturday morning, there are certainly clearly defined alternative arrangements that can be chosen in the actual distribution of working hours.

Male workers 20 years of age and over now receive not less than £8 per week, and female workers of 21 years and over not less than £6 1s. 6d.

Automation.

Some growers may have childhood memories of ploughing being carried out by means of a stationery steam engine using hawsers, pulleys and ploughshares. It must have seemed an awe-inspiring arrangement, a foretaste of mechanical wonders to come.

In 1960 we learn of tractors piloted automatically, once the initial furrow has been cut. Rather more advanced is the radio-controlled tractor, in which the pilot can sit in the centre of a group of fields and operate the tractors by remote control.

Fly Control.

A new approach to domestic fly control has been made by the *Standardised Disinfectants Co.*, in their "So-Dead" fly bait. Instead of taking the insecticide to the fly, in the form of sprays and dusts, the fly is attracted to its death by the use of insect attractants mixed with the insecticide. This is coloured blue, to avoid confusion in the pantry, and is placed on window sills or near dust bins and other places where flies like to congregate.

Facts and Figures.

Dutch mushroom production is estimated to be running at the rate of 5 million pounds a year

Continued on Page 159

" The one thing that has astounded Mr. Johnson about mushroom growing is the most extraordinary spirit of co-operation that exists in the industry "

STARTING FROM SCRATCH

GLYNN NURSERY, PEACEHAVEN

We thought it would be of interest to some of our smaller growers if we visited a new mushroom farm to find out some of the problems that face a beginner starting on a limited capital. Mr. Johnson came into the industry with an open mind and a capacity for hard work which have enabled him to establish a new and efficient mushroom farm.

STARTING from scratch Mr. E. W. Johnson has built up a compact mushroom farm of just under 5,000 square feet on trays in less than twelve months and on a capital investment of £5,000. He has gained valuable practical experience that will prove a firm foundation for future plans for expansion.

How did this venture begin? The idea of cultivating mushrooms was certainly not in Mr. Johnson's mind when he left England with his wife in a Land Rover, bound for the other side of the world. They were doing it the hard way, and motored right through to Calcutta before taking ship to Australia. Landing at Perth, they then drove from one side of Australia to the other, adding 3,000 more miles to the mileometer. But the itch to travel had not abated, so they went on to New Zealand, and then made a traverse from the tip of the North Island to the toe of the South Island. Still Mr. Johnson had not made up his mind to settle, so they took the boat back home.

It was on the return voyage that he met a New Zealander from Otago who had been bitten by the mushroom bug and was coming to England to find out all he could about commercial cultivation. As all growers know to their sorrow (or joy) the mushroom bug bites all within hearing distance, and before he landed in this country Mr. Johnson was determined to carry out a full and careful investigation

A view of Glynn Nursery from the south. The casing shed is on the left, the pasteurising shed on the right. The caravan is used as an office.

into mushroom growing with a view to making it his career.

Two months of looking around, of consultation and question, were enough to satisfy him that mushrooms *were* the answer and all that remained was to find a suitable place on which to set up shop. He then met his first obstacle, for he wanted to build both a farm and a house in which to live. It seems that this is quite an obstacle, for while there is plenty of land on which you can build a mushroom farm, and rather less on which you can build a house, there is relatively little land on which you can build both! At this time he set up an estate agency, no doubt invigorated by his activities in searching for the ideal site for his project, but needless to say, he has already learned that with mushrooms it is all or nothing, and he has practically no time to devote to this sideline!

Situation

At last he found what he was looking for, and in many ways it is an ideal situation. His farm stands on rising ground to the north of Peacehaven, about six miles from Brighton. There is a fine view out across the English Channel to the south, with the Downs mounting away to the north. Quite apart from the setting, his farm is close to an expanding market and set in an area with a high and rising standard of living — a point which Mr. Johnson has been quick to appreciate.

Mr. Johnson is a qualified engineer by profession and naturally mechanisation of all the processes of mushroom growing has been first and foremost in his mind in planning his farm. There is already plenty of concrete in evidence and he has not made the mistake that others have made — of leaving the concrete until he had the machines and then finding innumerable reasons why he cannot concrete and so make the work of the machines ten times easier.

Buildings

But the first decision he had to make was the type of house he was going to build and he was influenced here by the fact that a mushroom farm is by no means an easy thing to sell. In the early stages at any rate he wants to build a unit that could, if necessary, have a readily realisable value on the market. On a visit to Darlington's Experimental Farm he had been impressed by some trial houses that had been erected, using a combination of glass and polystyrene insulation. Here was a type of house that could if necessary, be used for growing other crops by simply removing the insulation, and a holding with

Externally applied polystrene insulation is covered with polythene sheeting secured by string netting

plenty of glass commands a good price on the market.

His first three growing houses, therefore, consist of tubular steel structure carrying Dutch Lights. They stand on 27 inch dwarf walls, with a span of 20 feet and they are 46 feet long. Each growing house will take 1600 square feet of trays, and yet they are spacious and airy. There is certainly a pleasant fresh smell about them — but that may be the breeze from the sea!

Insulation

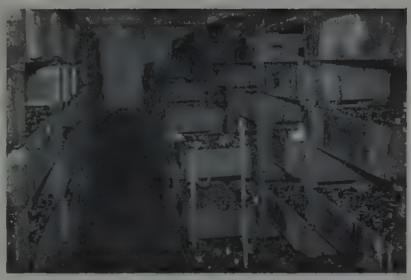
The first house was insulated externally, using polystyrene slabs over the glass, with an outer skin of polythene sheeting for protection, the whole held down by stout string netting. At first it seemed asking for trouble to insulate in this fashion on an exposed slope but it has withstood the worst gales the winter could throw at it and strangely enough the only place where he has trouble is where the polythene sheet was too firmly fixed by a steel straining wire. The slight movement allowed by the string netting seems to have given the polythene a degree of tolerance towards the effect of the strong winds.

The chief difficulty lay in applying the polythene over the polystyrene. Mr. Johnson draws a graphic picture of his struggle to control the long lengths of polythene as he sat on top of the house while the sea breeze did its utmost to blow them to the other side of the Downs! It was this that made him decide to apply the polystyrene slabs to the inside of the second house, fixing them to the wooden frames of the lights with galvanised nails. However this method has revealed an unexpected weakness in that the lights are by no means watertight! With the insulation applied externally there has been no chance for the rain to drive into the first house, but the second house has proved troublesome because of these leaks and Mr. Johnson has decided to put it on the outside of his third house.

Pasteurising

For pasteurising there is a Nissen-type hut, lined internally with wood, the cavity being packed with insulation. At the moment he is using a Maywick heater for boosting his temperatures but he realises that when he uses live steam — and some form of steam generator is high on his list of priorities — he will have to do something about sealing this inner lining or it will deteriorate rapidly.

There is also a hut for general storage and for the mixing of the casing materials — peat and chalk.



The interior of one of the three growing houses. The trays are at present stacked checker-board fashion.

Heating is by water from an oil-fired boiler installed by Tugnett & Co., who were also responsible for installing the ventilating system in the cropping houses and pasteurising rooms.

Ex-W.D. Boxes

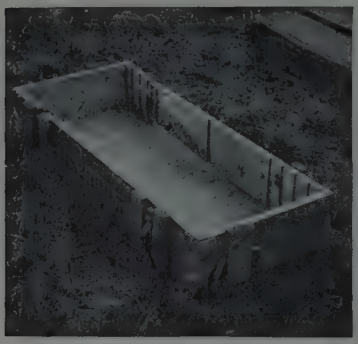
Mr. Johnson grows on trays and his unit is the ex-W.D. cordite box, a stout wooden chest with internal dimensions 36 inches by 14 inches. He answered an advertisement in the "Commercial Growers" to make contact with the supplier and has purchased a large number of the boxes at 2/4d. each. The boxes are beautifully made of sound timber that will last through many croppings, and as each comes complete with a lid, he has accumulated plenty of timber on hand for other jobs. The trays are stacked checker-board fashion at the moment but he is busy fitting them with legs so that he can go over to open stacking as soon as possible.

Composting is carried out in the open, the manure being put through a Chatsworth turner. For his first crops Mr. Johnson has carried out a conventional long composting process, for he argues that as he is under no pressure to keep his composting area continually on the move, it is more economical to carry out the composting process in the open over three weeks than to cut the time to ten days and give a prolonged and expensive peak-heat. In other words he can see little virtue in speeding up his composting process unless the whole farm is geared to an intensive method of production. That, he considers, can wait. First he is going to master the art of growing mushrooms by the traditional methods and then he will go on to experiment.

He has experienced difficulty in obtaining a satisfactory peak-heat and attributes this to bad timing of filling. He wants to get the compost into the house while the temperature is on a rising curve so that there is enough latent fermentation still left to raise the temperature almost to the required figure. This requires a nicety of timing that comes with experience, and Mr. Johnson is convinced that he will master it soon.

He has spawned with Grain Spawn, and on his first crop ruffled the grains well in with his fingers. On the next crop he through-spawned completely but has found that to do this using manual labour is a time-absorbing process, and feels that this can be done mechanically by the small grower using something resembling a miniature electrically powered rotary cultivator. This would allow open-stacked trays to be through-spawned in the stack, so cutting out the necessity of unstacking, spawning and re-stacking. In his most recent spawning he doubled the quantity of spawn used and is keeping a careful note of the speed of run and crop achieved.

The houses are ventilated with polythene ducting, twin ducts run-



One of the ex-W.D. Cordite boxes 36 inches long by 14 inches wide which Mr. Johnson uses for his compost.

ning the entire length of the house and punctured at intervals to give air jets over the trays. So far he has had excellent quality mushrooms and has averaged a pound and a half per square foot on his trays which he considers — and rightly so — not too bad for someone starting from scratch.

While he sends most of his mushrooms to market in the usual way he has found that there is a good local trade and one that he hopes to develop this summer. Like many other growers he has found that so far as local trade is concerned the volume of sales is almost entirely governed by the price, and by coming to an arrangement with a local shop he can move substantial quantities of mushrooms.

The one thing that has astounded Mr. Johnson about mushroom growing is the most extraordinary spirit of co-operation that exists in the industry. He has had some experience of other businesses in which competition is knife keen and he finds the readiness to help that exists among all growers almost too good to be true. From the moment he decided to grow mushrooms seriously he has received all the help and advice he could ask for, and it was given willingly and without strings attached.

Looking back over the months he has been growing, he has no regrets. It has been extremely hard work so far, for he has had to do almost everything himself, with a little part-time labour to help, and often he has been on the farm until after midnight in order to keep up with his schedule. Nevertheless he considers it well worth while and as he introduces machinery he feels that the hard physical labour will decrease.

Looking to the future, he plans to build steadily as he gains experience, integrating his expansion with mechanisation. It is too much to hope that mushrooms will rise again in price and therefore costs have got to be cut. The cost of labour can be cut by introducing machinery and this he is doing. As for his other principal cost — that of manure — he plans to make his own contracts. There are several riding stables in the district, and he is not a great distance from the racing stables at Lewes. By purchasing direct he hopes that another important item in his costs can be substantially reduced.

Mr. Johnson has established a 'going concern' in under twelve months starting from scratch, and it has been mainly his hard work that has gone into making the farm what it is. It has been planned with care and with an eye to the future, and there can be no doubt that if he continues on the path he has followed so far, he will have a sizeable and first rate modern mushroom farm in the not too distant future.

BOOK REVIEW

Mushroom News, Volumes 3, 4, 5 and 6

The last ten years have seen a complete revolution in the art and science of mushroom growing, and the collected issues of Darlington's quarterly journal *Mushroom News* covering the years 1950-1958, now offered in one bound volume, traces the steps from the almost leisurely pace of growing at the beginning of the decade to the frantic gallop at the end. It is only when one turns the pages that one realises just how the mushroom industry has advanced in so short a period of time.

In 1950 the Editor was stressing the importance of peak heating, stating that far too many growers remained unconvinced of the importance of this technique. Everyone used soil for casing, although there were signs that not everyone was satisfied with it, and in 1953 there is an article on ash as a soil conditioner. Almost the whole of the January 1951 issue is devoted to the tray system of mushroom growing, an article by R. G. Darlington that has been reprinted many times, and subsequently there was a heated controversy between the tray growers and the shelf growers that lasted for three or four years.

But while this book, containing thirty-two issues of the journal, is interesting as a history of an important decade, its real value lies in the articles dealing with practical mushroom growing. A grower can dig into it to find information on every aspect of mushroom cultivation from the construction and fitting out of a mushroom farm to the marketing of the crop.

There are F. C. Wood's articles on the diseases of mushrooms, and his studies on the weed fungi of mushroom beds. There is the series "Modern Mushroom Equipment", starting with the Chatsworth Manure Turner which remains a best seller to-day! And then there are the series of 'outside' articles covering visits to mushroom farms in which full details are given of how practical mushroom growing is carried out.

But the major articles provide the skeleton for the journal upon which the Editor has built up a solid body of sound, practical information about mushroom growing. Contributed articles on heating, ventilation, insulation and marketing will be of value to the newcomer, and will give a good refresher course to the experienced grower.

I have two regrets about this bound volume. Firstly I wish it had been possible to include the front covers, for these have always been of interest, whether showing pretty girls or mushrooms, and would provide quite an exciting album on their own. Secondly, I would like to have seen a really comprehensive index to the mass of information in the book, but Darlington's have given us enough already without the trouble and expense of such an extra. There is, of course, an alphabetical Table of Contents for each of the four volumes included in the book and it is not difficult to find the information you are looking for.

A.B.

Published by *W. Darlington & Sons, Ltd.*, 672 pages.

HEA

with '

Through-spawning using the 'Spawnmaster' spawning & casing machine and ten square feet mushroom trays.

TRIALS extending over several years at W. Darlington and Sons experimental farm at Angmering, Sussex, have provided convincing evidence that through-spawning of the mushroom beds gives a heavier total weight of crop.

Even more important for the commercial grower with a tight six or seven week schedule, the first pick comes in up to a week earlier, which means that the cropping period, before the houses have to be cleared, is correspondingly increased.

Various methods of through- spawning are being tried out in America, Switzerland, Germany and other countries as well as Britain. The principle of all of them is the same—to secure initial growing points for the mycelium from top to bottom of the compost, so that from the start the whole bed is being used. The conventional method of just spawning the surface means that the mycelium threads do not get to the bottom of the bed until much later.

There is a good deal of evidence to suggest that the mushroom crop does not normally take up all the nutrients in the compost and it is possible that an even run of mycelium through all levels enables the available food materials to be more fully utilised.

Mr. Robert Darlington told me that a series of trials in fifteen houses showed average increases in yield of 25 to 30 per cent. over comparable beds spawned in the conventional way. In subsequent trials, the casing was put on progressively earlier, and finally, satisfactory results were achieved with an interval of only eight to ten days, compared with 14 to 18 with the old method of spawning.

The first flush was heavier in the through-spawned beds and yield was about $2\frac{1}{2}$lb. per square foot, in six weeks, very much higher than the normal average for trays.

All the experiments were with grain spawn and it has been found that the compost can utilise bigger quantities when through-spawning is used. When the grains were broadcast over the surface, it was done at the rate of one carton to 100 square feet. Then it was ruffled into the surface at the rate of one carton to 40 square feet, and gave a correspondingly higher yield.

ER, EARLIER MUSHROOM YIELDS
HROUGH SPAWNING'
TECHNIQUES

by

H. G. SCHAFFER

The new technique of thoroughly mixing the spawn into the compost has now been tried on a number of farms and seems to give earlier and increased yields. In this article, reprinted by kind permission of the Editor of the Commercial Grower, *Mr. H. G. Schaffer describes the technique as practised on Darlington's Experimental Farm.*

Through-spawning started at one to 40 square feet, but gradually the rate was stepped up to one to 20 square feet A trial is now being done to compare one to 15 square feet with one to 20.

In the very early stages, even at the high rate of spawning, the grains are lost in the compost and there appears to be less, rather than more mycelial growth. Very quickly, however, the white threads fill the bed.

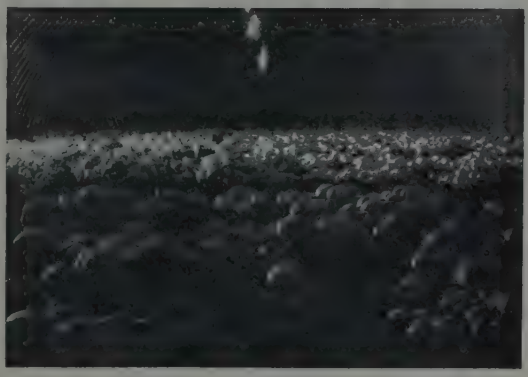
Mr. Darlington believes that other factors, as well as the quicker takeup of nutrients, are involved. He thinks it probable that with so many more points of innoculation, the mycelium is able to establish itself more quickly against competing organisms in the compost.

The shaking up of the compost during through-spawning improves the texture and eliminates those very compacted areas, which are often found after pasteurisation and which hold up the run of the spawn. This may be another reason for the improved yield.

Same Results.

Trials have also been carried out with shredded manure spawn and results have been very much the same.

The next development at the experimental farm was to introduce a spawning and casing machine.



Mushrooms by moonlight ! A fine first flush on compost that had been through spawned at the rate of one carton per fifteen square feet.

The fork lift truck carries the ten square foot trays into the shed where a spawning machine is in operation.

The Spawnmaster made by E. B. Burdon (Engineers) Ltd. of Woking was adapted to take the double sized trays used at Angmering. One tray filled with compost is emptied on to the top conveyor belt and the empty tray placed on the lower belt. The spawn is scattered over the compost as it moves forward at a specified rate. The compost next passes under a flail which thoroughly fluffs it up and mixes the spawn through its whole texture.

The movement of the empty tray on the lower belt is synchronised with this process, so that when it is completed, the spawned compost is poured into the tray. It is then tamped and moved on roller-conveyors for stacking on a pallet, to be taken to the growing houses. The rate of spawning is governed by the number of fork lifts available.

For casing, the trays are placed on the lower conveyors and the peat and chalk mixture is fed on to the upper belt. Casing is levelled off to the required depth and is carried forward to fall on to the compost. This method ensures an equal depth of casing over the whole surface and results in much more regular flushes and improvement in yield in the early stages of the crop.

During work at Angmering it has been found that yield falls if the compost is pressed down too hard — which fits in with the recent work on the need for an adequate supply of air to the growing mycelium.

It was found that if any disease organisms escape the pasteurisation, the shaking up of the compost spreads it through the bed. For this reason, the method is recommended only to growers who have peak heating facilities.

For growers who cannot install a machine, the method entails turning the tray out by hand and shaking the compost out with a fork after adding the spawn. This means an extra operation, but a 25 per cent. higher yield over the same growing period should more than justify the extra labour cost. The additional cost of spawn amounts only to about 2d. a square foot extra, which is easily covered by the higher yield.

For shelf growers, the only possible method of through-spawning would be to take a section out of the end of the bed, mixing the spawn with the compost as the bed is turned over.

A fine first flush of mushrooms in a house of ten square foot open-stacked trays which have been through spawned with Darlington's White Grain Spawn.

ATTACK ON INSECTS

World Health Organisation plans International Onslaught

Resistance to insecticides is a matter of world-wide concern, principally because those insects that have developed resistance to some of the more common insecticides are the ones that carry dirt and disease. It is these carriers, however, that are the ones most subjected to new insecticides and therefore are most likely to develop resistant strains.

The World Health Organisation in Geneva is organising an all-out onslaught on the problem, with the object of evolving new insecticides that will be so intensely tested that they will be as near perfect as possible. Seven laboratories will take part in the scheme, three in Britain, three in the United States and one in Tanganyika.

Screening some thousands of new potential insecticides that appear every year is going to be a big task, but the matter is of such vital importance to world health, that if only one 'possible' is isolated at the end of a batch, the research workers will feel it worth while. Many agricultural and horticultural insecticides, it appears, have never been tried as public health insecticides and one of these — discarded by the manufacturers for its original purpose — is already on the short list.

MYCOGONE

PERNICIOSA

(BUBBLE DISEASE)

by

F. C. WOOD, B.A. (Cantab)

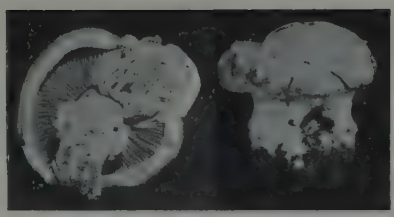
Although one of the oldest of the diseases of the Mushroom, Mycogone still persists wherever the crop is grown. It is responsible for very considerable losses every year and yet many mushroom growers continue to accept these as inevitable and to treat the disease with indifference. Under modern intensive growing conditions, Mycogone can become a serious epidemic. The following article is intended to emphasise the necessity of not underestimating the effects of 'Bubble' infection.

History.

IN 1907 L. Matruchot (1) described and discussed at some length, a disease of cultivated mushrooms called "la môle" by the French growers. This disease was having disastrous effects on the ecomony of French commercial mushroom cultivation, and Matruchot's opening paragraph reads as follows :—

"From an economic point of view, La Môle is the most important disease that attacks the cultivated mushroom. In the Paris region, which is the most favoured area for mushroom growing, there is, by and large, not a ridge-bed which is not more or less affected by this disease. If it is admitted, as preliminary statistics have shown, that approximately 10% of the produce is rendered unsaleable on account of this disease, it is obvious what an effect La Môle is having on mushroom cultivation. Discounting the outlying region around Paris, the annual loss amounts to more than a million francs and it is not uncommon to find a grower ruined and forced to abandon his business solely on account of an outbreak of La Môle — an outbreak he neither knows how to anticipate or check and which persists in his caves indefinitely".

Thus over half a century ago commercial mushroom growers in France were well acquainted with a disease that very soon became equally detested by English mushroom growers and caused them equally severe losses. According to Matruchot the name given to the disease by French growers — La Môle — was derived directly from the old French, the term meaning a shapeless mass, the description being a particularly apt one where bad attacks of the disease appeared. In England it is almost invariably called 'Bubble', the term being



Mushrooms attacked by Bubble. On the left the gills are deformed by a white felt-like growth. On the right the whole cap is being deformed.

descriptive of the brown droplets of liquid oozing from badly affected mushrooms.

General description.

A typical 'Bubble'-infected mushroom appears as a large shapeless mass breaking through the casing soil. In severe cases the lump of 'Bubble' may be as large as ones fist. The surface of this mass is covered with a white felt, this being the mycelium of the parasite fungus itself, known scientifically as *Mycogone perniciosa* Magnus. Within a few days, brown drops of liquid begin to exude from the surface of the affected mushroom and the whole mass begins to rot into a wet, evil-smelling mass.

In many instances where infection is not so severe the mushroom may show little signs of attack until the veil has broken. There is, in such cases, a definite differentiation into a stem or stipe and a cap or pileus. The former is, however, very often shorter than usual and the latter may be very irregular in outline. The gills, instead of being the normal healthy pink colour and running directly from the stem to the edge of the cap are now swollen, felt-like and characteristically undulating or sinuate and fused irregularly together to form an irregular network. In both cases the felt-like covering is made up of *Mycogone* mycelium consisting of a mass of fine strands of hyphae. These give off erect growths of *conidiophores* which are branched and the branches produce on their ends small spores or *conidia*. The spores are scattered by draughts, disturbance of the affected mushroom, flies, etc., and when they germinate, they spread the disease rapidly in the same house or in other houses on the farm. Since these conidia are fairly fragile they will not withstand adverse conditions for very long. *Mycogone* is, however, well equipped for such contingencies. As the affected mushroom rots, spores of a different type are produced in the soft, broken-down tissue which are characteristic of *Mycogone*. These spores are two-celled, the upper, rounded cell having a thick resistant cell-wall covered with minute spines, while the basal cell is thin-walled and cupshaped. These two-celled structures are known as *chlamydospores*. They can remain viable for years and serve to maintain the disease over long periods when conditions are adverse. It will be noted, therefore, that firstly *Mycogone* is highly infectious by virtue of its abundantly produced conidia and it can thereby rapidly infect a whole mushroom farm. Secondly, and equally important, it is also extremely persistent owing to its resistant, resting spores. It is therefore an ever present menace on a mushroom farm when it has once made an appearance.

Sources of Infection.

Mycogone is a soil contaminant and in most cases of the disease on a mushroom farm the *original* source of infection is from the soil. Where casing is carried out using

soil this constitutes the most obvious method of introduction. Top soil contains the bulk of the microflora consisting of fungi, bacteria, algae, and actinomycetes and it is in the top soil that *Mycogone* resting spores are usually found. For this reason, therefore, commercial mushroom growers, prior to the Second World War, used to insist on casing soil supplies being dug from the second spit or lower, the top soil being discarded beforehand. Even this precaution did not entirely obviate the risk of *Mycogone* infection. Second spit soil often contains small numbers of spores washed into the subsoil by heavy rain or, more commonly, due to top soil being accidentally included in with the casing soil load. Once the disease had gained entrance to the mushroom farm careless disposal of infected material and slipshod sanitary precautions quickly ensured that the farm premises themselves became the immediate cause of future outbreaks, the disease being carried all over the farm on workers boots and clothing, on chip baskets and picking trays, by every wheeled vehicle on the premises, by flies, and by being blown about by the wind. Steam sterilisation of the casing soil was very often not as effective as anticipated as *Mycogone* spores introduced subsequent to sterilisation usually gave rise to far more virulent outbreaks than usual owing to absence of competition from other organisms normally present in such soil.

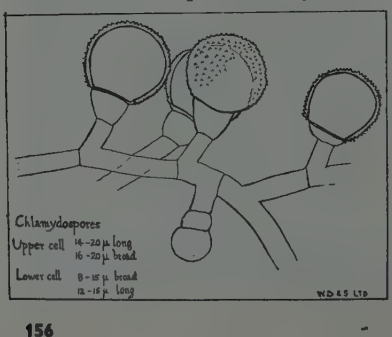


Fig. 1. Thick-walled resting spores—chlamydospores — which are resistant to adverse conditions. These enable the disease to persist on a farm over long periods.

After the second World War intensive housing programmes reduced available sites for casing soil to a minimum and a substitute for soil was found in peat and chalk. This medium very quickly took the place of casing soil. It was mistakenly assumed by many growers that *Mycogone* would no longer be a menace where the new casing medium was used. Disillusionment was speedy. Even better and bigger Bubble outbreaks occured. The explanation was simple. Peat and chalk casing could also be easily infected by *Mycogone*. In some cases it was obvious that the peat itself was suspect especially as, after casing, weed seeds often germinated freely in it. The presence of such seeds demonstrated very effectively the presence of top spit material in the peat. In far too many cases, however, the grower himself was entirely to blame. Peat bales were left lying around on the farm completely unprotected for weeks on end. Heaps of chalk were left in the same way. Large quantities of peat and chalk were mixed up for casing and the surplus left in a heap for future use, despite the fact that it might not be required for three or four weeks. *Mycogone* spores blew on to the heaps of casing material, careless workmen walked all over it, flies travelling from infected beds on the same farm or neighbouring nurseries, — all contributed a

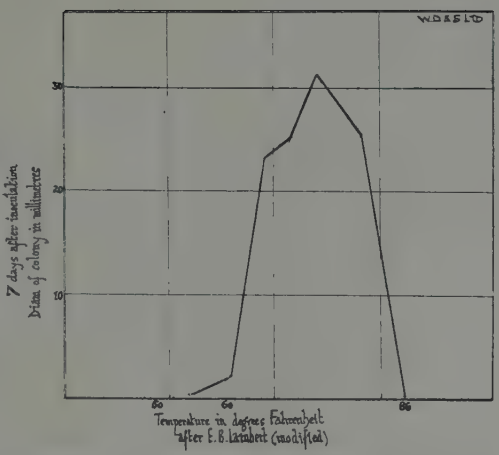


Fig. 2. Growth rate of Mycogone in relation to temperature.

mass of infection. Sterilising the peat medium had much the same result as had previously been experienced with casing soil — the operation was not entirely successful. It became more and more obvious that the answer was to eradicate the disease from the farm itself and then take precautions to prevent its re-entering.

Conditions favouring the growth of Mycogone.

Mycogone infection was a serious problem under the less intensive methods of mushroom cultivation, (i.e., ridge beds, flat beds in glasshouses, and shelf beds). The sanitary precautions often left a good deal to be desired but more important was the fact that the use of casing soil maintained an ever present danger of re-introducing contamination. Under modern methods of growing, peat and chalk casing (given reasonable care) need not provide a constant source of infection. Yet these same intensive methods can be the greatest factor in transforming a small infection of 'Bubble' into an epidemic since they provide ideal growing conditions for the parasite.

E. B. Lambert (2) showed that the most prolific growth of *Mycogone* takes place between the temperature ranges 68° - 82°F. At 59°F. the growth rate was extremely slow while at 50°F. it was brought almost to a standstill (see Fig. 2). Lambert also carried out experiments whereby trial areas of mushroom beds were cased with *Mycogone*-infected soil at various constant temperatures and were compared with control beds cased with sterilised soil and kept at the same temperatures.

At 70°F. and at 60°F., 100% infection occurred; at 50°F. only a small amount of infection was observed. Moreover, if the highly infected areas at 70°F. were cleared of *Mycogone* and the temperature dropped to 55°F. the subsequent *Mycogone* growth was very greatly reduced.

These experiments emphasise the fact that under intensive tray cultivation where the spawn is run at high temperatures, even small infections of *Mycogone* are encouraged to grow at a maximum rate.

Method of infection by Mycogone.

J. Chaze and A. Sarazin (3) carried out a series of experiments to determine the relationship between *Mycogone* and the mushroom. They inoculated mushrooms with spore suspensions of both types of *Mycogone* spore. In neither case was it easy to produce even a moderate amount of infection — the

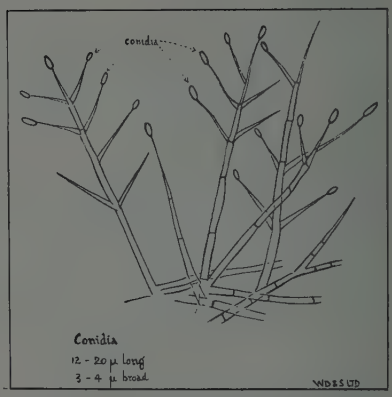


Fig. 3. Thin-walled spores or conidia which are produced in vast numbers on the white, felt-like mycelium by which the disease spreads rapidly.

developing mushrooms offered a marked resistance to the parasite. Infection appeared to take place in the spawn strands in the casing itself, particularly if these strands happen to be injured or dying. From this initial infection the disease then spread to the surrounding strands. Saragin (4) also claims that the cultivated mushroom has normally a natural immunity to Bubble due to excretory products that prevent the growth of the disease. He claims that attack by Bubble takes place when the mushroom excretory products fail to appear or are neutralised.

Thermal death-point of Mycogone

In his investigations on 'Bubble', E. B. Lambert showed that the disease spores are susceptible to quite low temperatures and exposure to 106°F. for a period of 6 hours was quite effective in producing a complete kill.

Control of Bubble on the mushroom farm.

Control of *Mycogone* on a commercial mushroom farm involves :—

(a) Keeping the infection under control and confined to the affected house or houses ;

(b) Preventing the carry-over of the disease from one crop to another.

Where moderate infections occur in a house one employee should, if possible, be detailed to go round before picking begins and take out all affected mushrooms, carefully putting them immediately into a bucket containing strong disinfectant. This procedure helps to reduce the danger of pickers carrying *Mycogone* all over the farm on their clothes, footwear, and picking baskets, After completing his task the worker responsible for picking off the infected mushrooms should then wash his hands thoroughly before working on other jobs.

As soon as practicable after clearing off the diseased mushrooms, the beds should be thoroughly dusted with 75% Zibimate which will materially help to prevent the germination of *Mycogone* spores scattered about during the clearing process. If cropping has been maintained at temperatures *above* 58°F., infections will be greatly reduced if the house temperature is lowered to this figure. It has already been emphasised that the growth rate of 'Bubble' increases enormously as the temperature rises to 70°F.

Where very heavy infections occur drastic measures are frequently necessary. In one case investigated by the writer, a house fitted with trays with a total cropping area of several thousand square feet (cased with peat and chalk) produced a first flush consisting solely of 'Bubble'. The method carried out, under the writer's supervision, was as follows: The whole of the diseased

mushrooms were picked off and burned and the barrows, etc., washed out with 2% formaldehyde solution before further use. The casing was allowed to dry off for three days and the temperature dropped to 55°F. The whole of the peat casing was then mist sprayed using 2% formaldehyde solution. The house was also fumigated with formaldehyde gas and was left shut down for 24 hours. After this the house was ventilated until all the formaldehyde fumes were dispersed and the peat casing was watered. Subsequent flushes were almost free from trouble and were maintained in that condition by regular treatment with 75% Zibimate. It was discovered subsequently, that this massive infection had arisen solely from the use of a few barrowloads of very old casing material that had been lying around the nursery for months, being mixed in with the new supplies of peat and chalk.

After a house has finished cropping there is obviously a danger of spreading any infection present in the house all over the farm during the emptying of the beds or trays. To prevent this, the most efficient method is to cook out the house before emptying. Owing to its low thermal death-point even a moderate temperature is effective (106°F. for at least six hours) and the heat can be supplied by any of the recognised methods such as live steam or braziers. If cooking out is not possible then the only alternative is to fumigate or, better still, spray out the house and its contents with formaldehyde. For fumigation the gas is liberated from 40% formaldehyde by potassium permanganate crystals; for spraying the formaldehyde solution should be a 2% strength.

References :

(1) *La Culture des Champignons comestibles*, May, 1907, pp. 18-19.

(2) LAMBERT, E. B. (1930) *Phytopathology*, Vol. xx. i.

(3) CHAZE, J. and SARAZIN, A. (1935) *Compt. Rend. Acad. Sci. Paris*, 200 : 855-57 and 1781-83.

(4) SARAZIN, A. (1950) *Mushroom Science I*, p. 93.

Notes and News *(Continued from page 143)*

cropped by 520 growers on a total capital investment of £1,200,000. Estimated production in the United States is now running at 110 million pounds a year, giving a consumption of 10 ounces per head of the population. Consumption of mushrooms in the United Kingdom is estimated to be about a pound per head per year, and in France the consumption is reckoned to be 2½ pounds per head per year.

Buying by T.V.

Among plans proposed by the French Government for modernising horticultural marketing is one for linking markets in the production areas with markets in the cities by television. Thus it will be possible for a greengrocer in Paris to view produce for sale in a country district many miles away, and buy for direct delivery, so saving time and money.

As a safeguard, only approved producers would be permitted to use this television service, and it would be covered by adequate inspection of produce in the provincial markets by market inspectors.

Some items of interest from our Postbag

Use of Gypsum

I have read conflicting opinions on when to add gypsum during composting. I am still a beginner, and would be glad of any help you can give me on this point.

Our policy has always been to advise adding gypsum in the later stages of composting for the following reasons.

Theoretically the early addition of gypsum should bring about the required results and its effects should last throughout the rest of the composting process. In practice this does not turn out to be so, and we find that during conventional composting the effect is not maintained at later stages of the process. You will realise that this can become serious, for the farther composting proceeds the more likelihood there is of the compost becoming wet and greasy, especially during the winter months.

We therefore advocate adding gypsum in the later stages, for its effect then becomes immediately apparent and what is more important, the effect lasts long enough to maintain the compost in the correct condition.

Pasteurisation

When I filled my trays before peak heating the compost seemed just right so far as moisture goes. After the peak heat the compost was very wet, and cropping has been poor. I enclose a sample and would like your opinion as to why it got so wet.

From the information you gave us over the telephone, we learnt that you stack your trays one on top of the other so that the bottom of one tray is almost pressing down on the compost in the one below, and that you build them into blocks of trays.

The result of this method of stacking is that you have a solid mass of compost in your peak heating room into which it is extremely difficult for the heat to penetrate. Not only does the heat fail to get into the centre of the stack, but there is no way by which the steam or ammonia given off can escape from the compost. Consequently you are making a greasy compost that is not being properly conditioned during the peak heat.

We suggest that you make gaps between the trays of *at least* one clear inch, either by putting batten between them at the time of stacking, or by putting corner posts on the trays. In this way you will give increased facilities for air flow in all directions over the surface of the tray and so allow you to carry out an effective pasteurisation.

It would also help if the trays were fairly loosely filled during the peak heat to allow heat penetration and aeration. After peak heating the compost should be firmed down when spawned. If necessary, extra trays of compost could be included in the peak heating room, the contents of these being used to "top up" the rest of the trays and fill them to capacity.

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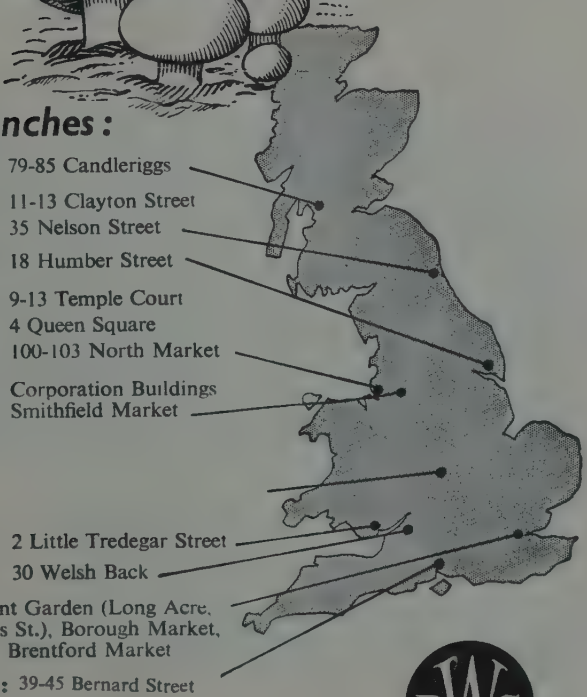

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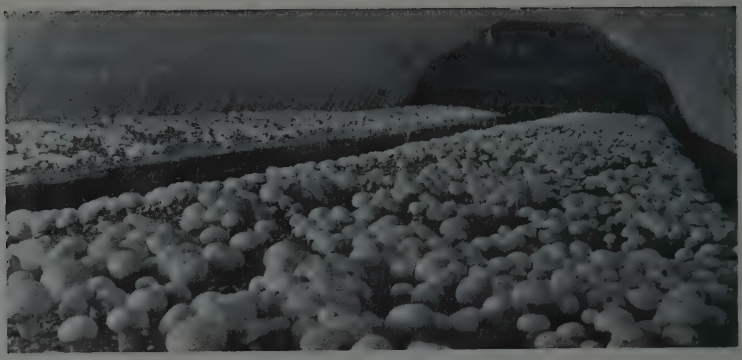

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DAN WUILLE & CO, LTD., 30 Welsh Back, Tel.; Bristol 26351-2 Telegrams: Wuille Bristol.

Cardiff

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BROOME & GREEN (LONDON) LTD., 27 James Street, Covent Garden. Tel.: Temple Bar 7856 Telegrams: Bourgaize, London.

CHARLES KNIGHTS, LTD., 501, 2, 3, 4, 5, Central Market. Tel.: TEMple Bar 5272, 9867.

DAN WUILLE & CO. LTD., 100-104 Long Acre, Tel.: TEMple Bar 7952, Telegrams: Wuille, Rand, London.

Leeds

J. WOOD & SONS, Kirkgate Market, Leeds, 2. Tel.: Leeds 30138. Telegrams: Woods, Leeds 2.

Manchester

SOMERS & GIBSON, LTD., Smithfield Market, Manchester 4. Tel.: Deansgate 3666. Telegrams: Muscatel, Manchester.

FRED BRIDGE, Smithfield Market, Manchester 4 Tel.: Deansgate 4835 & 2802. Telegrams: Fred Bridge, Manchester. Established 1888

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DAN WUILLE & CO, LTD., 39-45 Bernard St. Tel.: Southampton 27733 Telegrams: Wuille, Southampton.

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CHARLES KNIGHTS, LTD., 220, 2, 3, Brushfield Street. Tel.: BIShopsgate 6848/9.

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CHARLES KNIGHTS, LTD., 24, 25, 26, 27 Channelsea Road. Tel.: MARyland 2070.

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JAMES HODGSON, Brook Street, Wakefield. Tel.: Wakefield 2894. Telegrams: Radish

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